LESP

Lessard Proposal

From cards & head. 30 June 67

This note will discuss in detail certain aspects of a videotape editing console under computer control.
The general design was discussed in an earlier note,
"A Sophisticated System for Videotape (and Motion Picture) Editing."

Several aspects of technical implementation will be discussed here.
One aspect is the electrical interface and control among the
various component units.
Another is the form of storage and filing.
Another is the method of handling shot assembly by written descriptions,
an unusual technique.
Last, exsmples will be given of specific procedures that may be
employed in shot rearrangement. However, these examples will be
simplified and inefficient compared to what may be worked out.

Although computer control of the videotape recorder (VTR) is a new application, computer control of things in general is an old problem, and signal pulses from equipment to the computer are also a conventional matter.
things in general have been tied to computers for years,
and arranging

The exact connections to be made will depend on the technical details of the VTRs employed, and the relative simplicity and cost of particular connections.

Presumably the basic functions of the VTR are under solenoid control from the computer. These include Play, Record, Rewind, and Mark (establishing an edit marker on an editing track of the tape). They may also include Fast Forward, Step (move forward one frame), and Backstep (move backward one frame). Slow Forward and Slow Back might also be useful.

Signals from the VTR to the computer will also be required. The selection of the most simple, practical or efficient signals will require detailed study. These presumably will include voltage pulses or levels indicating the current motion (forward or back, fast or slow) and state (play, record, nothing).
A frame pulse, indicating the passage of a complete frame, is probably desirable; this could be gated by the flyback or blanking signals of the video. However, it should be independent of whether the VTR is going forward or backward, fast or normal.
A way should also exist whereby the VTR may indicate that it has reached a destination-- beginning of tape, end of tape, or edit mark; these might all be combined into a "completion" signal.

The switching matrix must also be subject to computer control. Different signals by the computer must be able to connect

specific video outputs with specific video inputs, ~~specific audio outputs with specific audio inputs,~~ and manage fades, dissolves and mattes. ~~(video) and mixes (audio).~~

It must also do the equivalent with audio, handling mixes and audio levels.

A comparatively simple method would be as follows: designate a number of video "lines" to which video outputs and inputs may be attached, under computer control, and associate a potentiometer, under computer control, with the input and output video intensity of each VTR.

Similarly for audio. Each VTR may have an audio input and output potentiometer under computer control, and be connectable byt the computer to specific audio lines.

Special output equipment, then, would have to perform instructions such as the following (for which coded equivalents would be sent out by the computer. (Note that some of the equipment, including the decoding system, is available from the computer manufacturers.)

CONNECT VTR 1 VIDEO OUTPUT TO LINE A
SET VTR 1 VIDEO OUTPUT CONTROL TO FULL
CONNECT VTR 4 VIDEO INPUT TO LINE A
SET VTR 4 VIDEO INPUT CONTROL TO FULL
CONNECT VTR 1 AUDIO OUTPUT TO LINE X
SET VTR 1 AUDIO OUTPUT POT TO HALF
CONNECT VTR 2 AUDIO OUTPUT TO LINE X
SET VTR 2 AUDIO OUTPUT TO 3/4
CONNECT VTR 4 AUDIO INPUT TO LINE X
SET VTR 4 AUDIO INPUT POT TO FULL

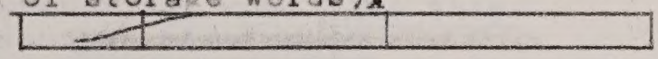
It will be seen that this set of commands makes connections that will, when the machines are started appropriately, perform a video transfer from 1 to 4 and an audio mix from 1 and 2 to 4. Since all the above commands may be sent out by the computer in less than 1/1000 of a second

The pots may be continually reset during a run, performing a mix as desired.

Because of the considerable speed of modern computers, even small ones, even a small computer can change the setups of eight connections and sixteen potentiometers in less than the time of one frame; the only limitations are likely to be electromechanical, the speed of the mechanical switching system. (If dozens or hundreds of VTRs were employed, this picture would change, of course.)

The form of storage of information about the videotape would be in a system of computerized formats, describing the shots, the points on them, and the ranges within them, which are important or significant to the editor.

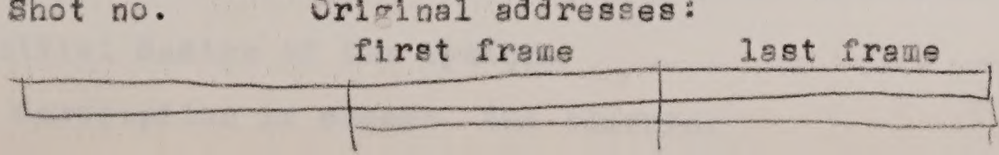
Specific cutting-points and frames on the videotape would have addresses decipherable by the computer. One possible such address would be a frame address, as follows: (the oblong represents a computer record, or succession of storage words)



VTR number frame number marker number on this tape (if edit marker has been placed with it)

In what follows I will discuss the more basic aspects of filing and handling -- not such sophisticated aspects as those dealing with storage of the entire script, alternative cutting-points for the same shot, and so on.

A list of shots would be stored in the computer, allowing each shot to be sought by number within the computer. (A "shot," in this designation, may overlap or contain another "shot." Moreover, it may be stored on more than one VTR, a considerable advantage in effecting speedy transfer for an editor's examination.

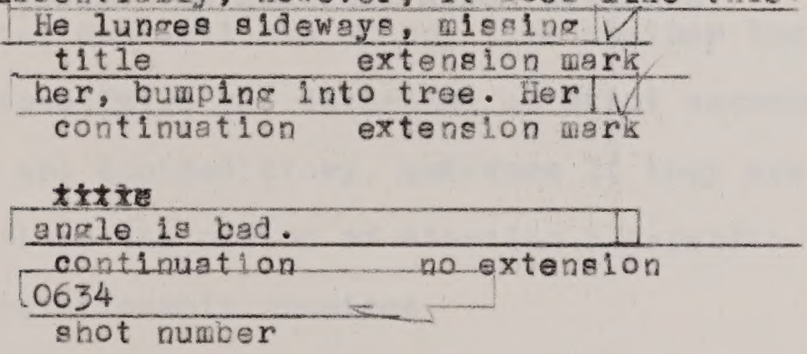


The editor

In one possible system, the editor would cause the computer to rearrange shots by typing in their shot numbers in the new, desired order on an input teletypewriter. (My guess is that if one were to approach the best-known computer company, such a system is just what they would propose.)

A much better system, however, would allow new sequences to be created much more easily, and without typing numbers. In particular, I would propose that the editor be allowed to create names or descriptions of shots, and assemble new sequences by checking off these lists as they roll past, backward or forward, on the screen.

The means of listing the shot titles, and rolling them on the screen, are aspects of computing technology proper and will not be discussed here. Essentially, however, it goes like this:



The title or description may have any length, the length being indicated to the computer by a series of extension marks. The shot number, which the editor need not see, follows.

This part of the system can be made extremely flexible, depending on what is wanted. Some editors may <u>want</u> to work with numbers. Others may want a common description stored for all the different shots of the same event, with qualifying phrases or codes alongside. All this is relatively simple to tailor, if adequate provision is made in the initial design of the system.

When a shot description is chosen, the computer

examines its number, looks up its number in the shot address table, and transferms it accordingly, taking account of the generations of level of the available versions.

A number of special relationships

In the obvious simple approach, the editor would have to specify the exact sequence of shots that he wanted. However, subtler methods may be possible that demand no more exactness from the user than really exists in his mind. For instance, the editor might specify relations that existed between two shots, such as "this comes somewhere before this" and "if I use this I can't use that." The system can inform him at any time as to whether he has worked his way

By specifying such relationships one at a time, he can gradually build a file of guiding information in computer storage, working his way toward the eventual exact sequence.
The system can tell him at any time whether the set of relationships he has specified yet determine an exact sequence, or whether any of them are contradictory, If they are contradictory he can be given the option of starting a separate file with a different set of relationship premises.

No such system exists today, but that is because subtle creative applications of this type have so far been avoided by systems analysts, and not because there is anything inherently impractical about it. However, this aspect of such a system would be comparatively experimental, and presumably require a lot of work to devise functions that please the user but are logically analyzable by the machine.

The following relationships could be among those stored int the machine, and taken into account during assembly:

This shot comes after that shot

Cut about here

This part of the shot is unusable, but the parts around it are good

Cut

Begin shot with this frame

End shot with this frame

Begin shot xx about here

End shot about here

The following are obvious pieces of information about the tape that needs storage:

The following are more subtle pieces of information about the tape that might be taken into accouxnt:

Lap range may go from here to here

A function we may call "lap control" is possible within this system. By "lap control" is meant the creation of specialx controls for trying different transixtions from shot to shot. The "first lap rxxxxx xxx field" is the succession of frames among which the first shot must end; the "second lap field" is the succession x of frames among which the second shot must begin. By placing the first shot onx one buffer VTR and the second shot on another, we may obtain successive views, under computer control, of different possible laps. Exact adjustments of timing could be made by thumbwheels, or other custom controls, as desired.

A number of possible methods might be used for control of VTRs and the timing of shots. The most obvious is the use of edit markers of the Editec type, as is done now. However, unless exactly defined spots are used for the beginning and end of every shot the editor wants to work with-- an excessive restriction-- this technique would require supplementation. The simplest method is to have the computer count individual frames, as well as take edit marks into account. However, it might also be possible to use a clock-- a computer timing device that could time specific shots to the thousandth of a second. What specifics would be preferable depends on details of implementation.

Another scheme would distribute edit marks at regular intervals evenly throughout the videotape, so that clocking or frame counting would have to proceed for only short distances.

Yet another technique would create an address channel on the cue track of the videotape itself, so that the computer could always ascertain the absolute position of the videotape. This would be particularly advantageous if an address register could be installed on the VTR, so that the computer would not have to be continually interrupted to keep track of the progress of the different machines. This interrupt scheduling is the most difficult part of the whole system, and such an external search feature would be a great advantage.

SET VTR 3 TO RECORD

START VTR 3

HOW TO COPY FROM ONE VTR TO ANOTHER

Connect VTRs appropriately to same line
Give PLAY and START commands to source VTR

Give RECORD and START commands to target VTR

Begin counting frames; each time a frame pulse arrives, interrupt current program and subtract one from the frames left to go.

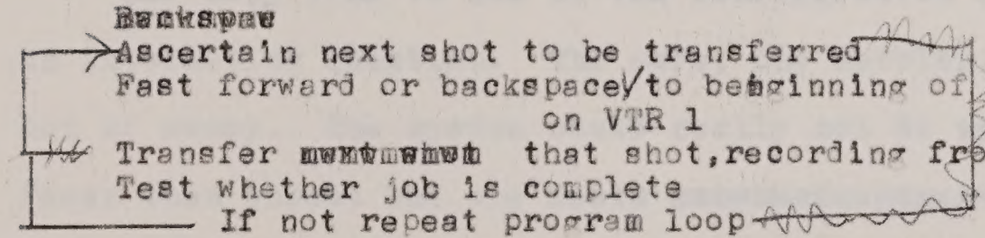
Alternatively: set timing register and compare it repeatedly with clock, till it matches or exceeds time shown at clock.

SORTING METHOD (inefficient) to transfer sequence to VTR 2 from out-of-sequence on VTR 1

Create list of shots to be transferred, in order

Ascertain length by adding up lengths of component shots

Make sure this is not greater than available blank tape on VTR 2


Ascertain next shot to be transferred
Fast forward or backspace to beginning of that shot on VTR 1
Transfer that shot, recording from 1 to 2
Test whether job is complete
If not repeat program loop
If so, stop

PROCEDURE FOR FINDING A SHOT ON VIDEOTAPE (somewhere on VTR 5)

Look down the list of shots now stored on VTR 5, testing whether each is the desired shot number.

When and if that shot number is found, ascertain

its address on the tape.

Subtract that address from the current position.

If resulting direction Go forward or back the required number of shots or frames, depending on whether the result is negative of positive.

Example: Suppose the shot you want begins at frame 900.

The VTR is currently positioned at frame 1450.

	Desired position	900
Minus	Current position	-1450
		- 550

The VTR is then backspaced 550 frames.

Whether to use frame count or edit mark depends on stopping accuracy of edit mark and question of whether we might ever miss a frame pulse.

The methods used for sorting and allocating space among VTRs will be subject to analysis and considerable improvement. This falls within the realm of "optimizing," and is not relevant to this paper. However, an example is the possibility of overleaved transfer: while the editor is looking at one thing, the computer can be setting up something else entirely on machines not currently involved.

How many VTRs to use in the configuration is obviously an interesting question. The more, the merrier; but they cost a lot of money. The system could really not do very much with fewer than three; but one feels instinctively that over five would be extravagant. The problem is easily settled from the point of view of computer software: the computer program must be able to function similarly regardless of how many VTRs are available during a given session.

It might be that three to five top-quality VTRs would be used for the masters and the final copies, but economy models with less fidelity could hold intermediate assemblies.

The most suitable use of the cue track is an interesting question.

(to show text-label sort)

SHE STEPS X TOWARD HIM, (her hair streaming behind)

Arrangements may be made x to leave out parts of the ~~xxxxxx~~ descriptive details that are not needed in a given assembly task.

It should be noted that "lap control" techniques, as mentioned above, tie up two VTRs at once and thus may interfere with overleaving.

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